

A REVIEW OF TWO WESTERN AUSTRALIAN SHRIMPS
OF THE GENUS *PALAEMONETES*, *P. AUSTRALIS* DAKIN 1915
AND *P. ATRINUBES* SP. NOV. (DECAPODA, PALAEMONIDAE)

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ABSTRACT

Palaemonetes atrinubes sp. nov. from marine and estuarine habitats of north and west Australia is described. *Palaemonetes australis* Dakin from fresh-water and estuarine habitats of south and west Australia is redescribed and data on the variation in the mandibular palp is included. The use of the mandibular palp as a single character to form generic groupings within the Palaemoninae of the world is only partially successful. The affinities of *P. australis* and *P. atrinubes* with other Australian Palaemoninae are discussed and a key to the Australian species of *Palaemon* and *Palaemonetes* is given.

INTRODUCTION

In his major revisions of the Indo-Pacific and American Palaemonidae, Holthuis (1950, 1952) regarded the mandibular palp as a character of generic importance. After grouping species with branchiostegal spines and without supraorbital spines he classified species with mandibular palps into the genera *Creasaria*, *Leander* and *Palaemon* while species without mandibular palps were classified into the genera *Leandrites* and *Palaemonetes*. Despite these groupings he considered *Palaemonetes* to closely resemble *Palaemon* stating that the 'only difference of importance is that in *Palaemon* the mandible possesses a palp, while this palp is absent in *Palaemonetes*'.

In the same revisions Holthuis used the number of segments in the mandibular palp as a character of subgeneric importance. Within the genus *Palaemon* he grouped species with branchio-stegal groove present, pleura of fifth abdominal segment pointed and rostrum without elevated basal crest. In this group species with mandibular palps of two segments were classified as subgenus *Paleander* while species with mandibular palps of three segments were classified as subgenus *Palaemon*.

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More recently Fujino and Miyake (1968) found intraspecific variation in the number of segments of the mandibular palp in five of the species included by Holthuis in the genus *Palaemon*. In each species a palp with three segments was the most common form and the number of segments varied between the following values: *Palaemon paucidens*, 1-3; *Palaemon serrifer*, 2-3; *Palaemon macro-dactylus*, 2-4; *Palaemon pacificus*, 2-3; and *Palaemon debilis*, 2-3.

In a further study of *Palaemon debilis* Chace (1972) found that the mandibular palp was absent in each of 'nearly 100 specimens examined from several Hawaiian localities', in 12 of 25 specimens from Raroia Atoll and in 'a very small percentage' of specimens from the Palau Islands. He concluded that 'the form of the mandibular palp, or even its absence, is of minor importance in *P. debilis*' and drew attention to the doubtful status of the genus *Palaemonetes*.

In *Palaemonetes australis* from Western Australia, both Dakin (1915) and Serventy (1938) considered the mandibular palp to be absent. In 1969 Monzu (unpublished honours thesis, University of Western Australia) examined about 50 specimens of *P. australis* from the lower Swan River and found that about 20% of these did possess a mandibular palp with either one or two segments. In the present study of *P. australis* from many locations in south west Australia some specimens from each location did possess mandibular palps. These results cast further doubt on the validity of the current definition for the genus *Palaemonetes*, based simply on the absence of the mandibular palp.

During this study a new species of *Palaemonetes*, *P. atrinubes*, was found from the lower Swan River. This species lacks a mandibular palp and is the second species of the genus *Palaemonetes* to be recorded in Australia.

SUBFAMILY PALAEMONINAE

Shrimp with pleura of second abdominal somite overlapping those of first and third segments; first pereopod chelate and usually more slender than second pereopod; carpus of second pereopod not subdivided; third pereopod without chela; third maxilliped with pleurobranch at base; walking legs without exopods, epipods or arthrobranchs; rami of bifid antennular flagellum fused in basal portion; second pleopod of male with appendix masculina; posterior margin of telson with two pairs of spines and two or more setae.

GENUS PALAEMONETES HELLER

Shrimp with branchiostegal spine and branchiostegal groove but without supraorbital spine, appendix interna on first pleopod of male, or mandibular palp (except *P. australis* which often has a palp with one or two segments).

PALAEEMONETES AUSTRALIS

Palaemonetes australis Dakin, 1915; Serventy (1938).

Diagnosis

A species of *Palaemonetes* usually without mandibular palp but sometimes with mandibular palp of either one or two segments; rostrum armed with

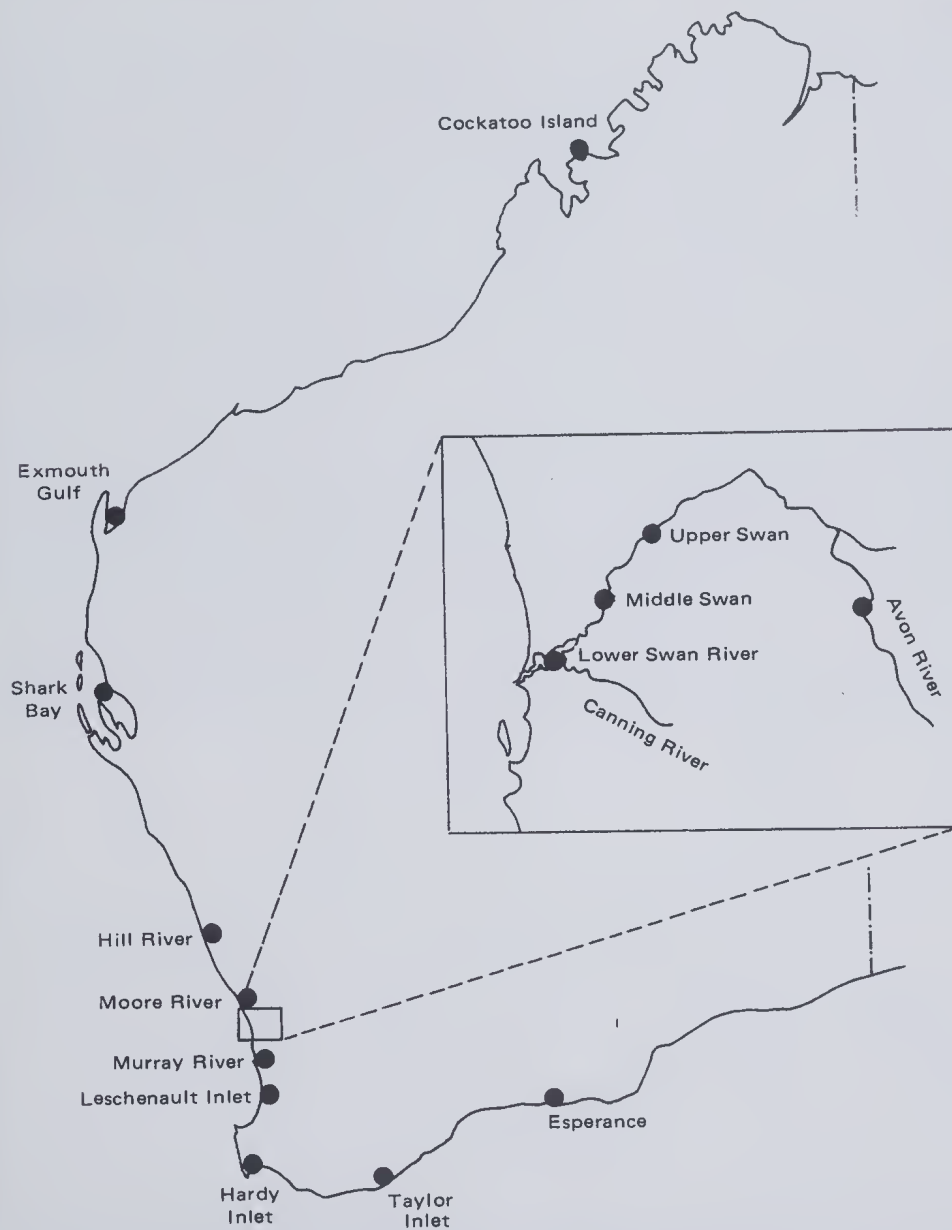


Fig. 1: Locations for samples in Western Australia.

regularly spaced dorsal teeth, bifid or trifid tip and rostral formula 4-7/2-4; branchiostegal spine distant from anterior margin of carapace; second pereopod reaching beyond scaphocerite by about half of chela; chela of second pereopod shorter than carpus; thickened ramus of bifid antennular flagellum up to twice as long as fused basal portion and eggs measuring about 1.1 x 1.6 mm.

Material examined

Neotype — Adult female, 36 mm total length, Upper Swan Bridge, 12.9.73, WAM 108-75.

Paratypes — 147 males (13-39 mm total length), 146 females (13-45 mm total length), 12 juveniles (6-12 mm total length) from Hill River; Swan River; York, Avon River; Murray River; Hardy Inlet; Taylor Inlet and Esperance (Fig. 1). WAM 36-74, 96-75, 102-75, 101-75, 92-75, 93-75, 107-75, 100-75, 109-75, 103-75, 110-75, 97-75.

Drawings are based on the neotype except for drawings of mouthparts and pleopods which were based on material dissected from paratypes as indicated in the descriptions.

Description of neotype

The depository of the type specimens was not given in Dakin's (1915) description and his specimens could not be located at either the Western Australian Museum or the Australian Museum (per. comm. D.J. Griffin 1974). An ovigerous female of 36 mm total length collected at the Upper Swan Bridge (12.9.73) is designated as neotype and is described as follows:

Rostrum (Fig. 2) curving up at tip; tip bifid, reaching to end of scaphocerite; dorsal margin with six regularly spaced teeth, sixth tooth located posterior to orbit; ventral margin with three teeth.

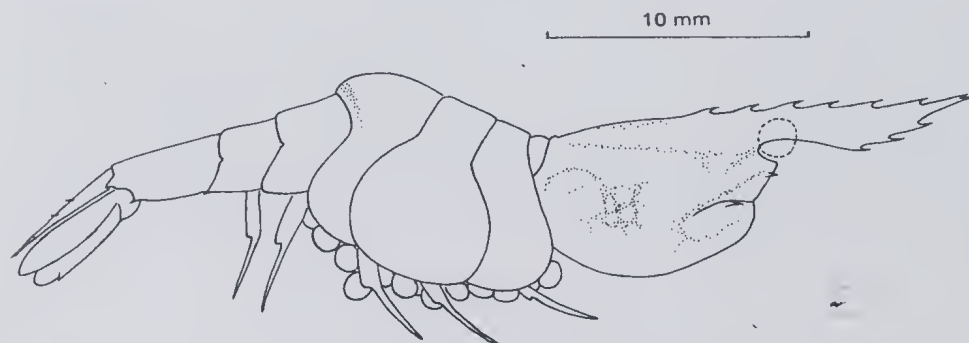


Fig. 2. General body shape of *Palaemonetes australis*. Stippled areas represent colour pattern on carapace and 3rd abdominal segment.

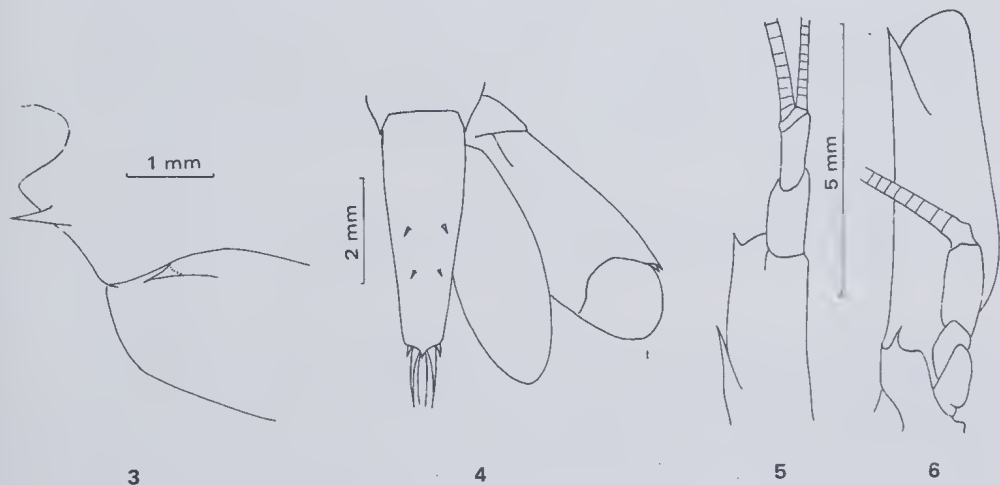
Carapace smooth; branchiostegal spine (Fig. 3) as large as antennal spine and distant by about its own length from anterior margin of carapace; base of branchiostegal spine visible as a line with dorsal side forming part of branchiostegal groove and ventral side commencing anteriorly at branchiostegal groove but not joining that groove posteriorly; branchiostegal groove rising dorsally from margin of carapace to dorsal side of branchiostegal spine then curving ventrally beyond that spine.

Pleura of three anterior abdominal somites rounded (Fig. 2), fourth pleuron bluntly acute, fifth pointed and acute. Third abdominal somite (Fig. 2) markedly recurved posteriorly, viewed laterally. Sixth abdominal somite one and three quarters length of fifth somite and about as long as telson.

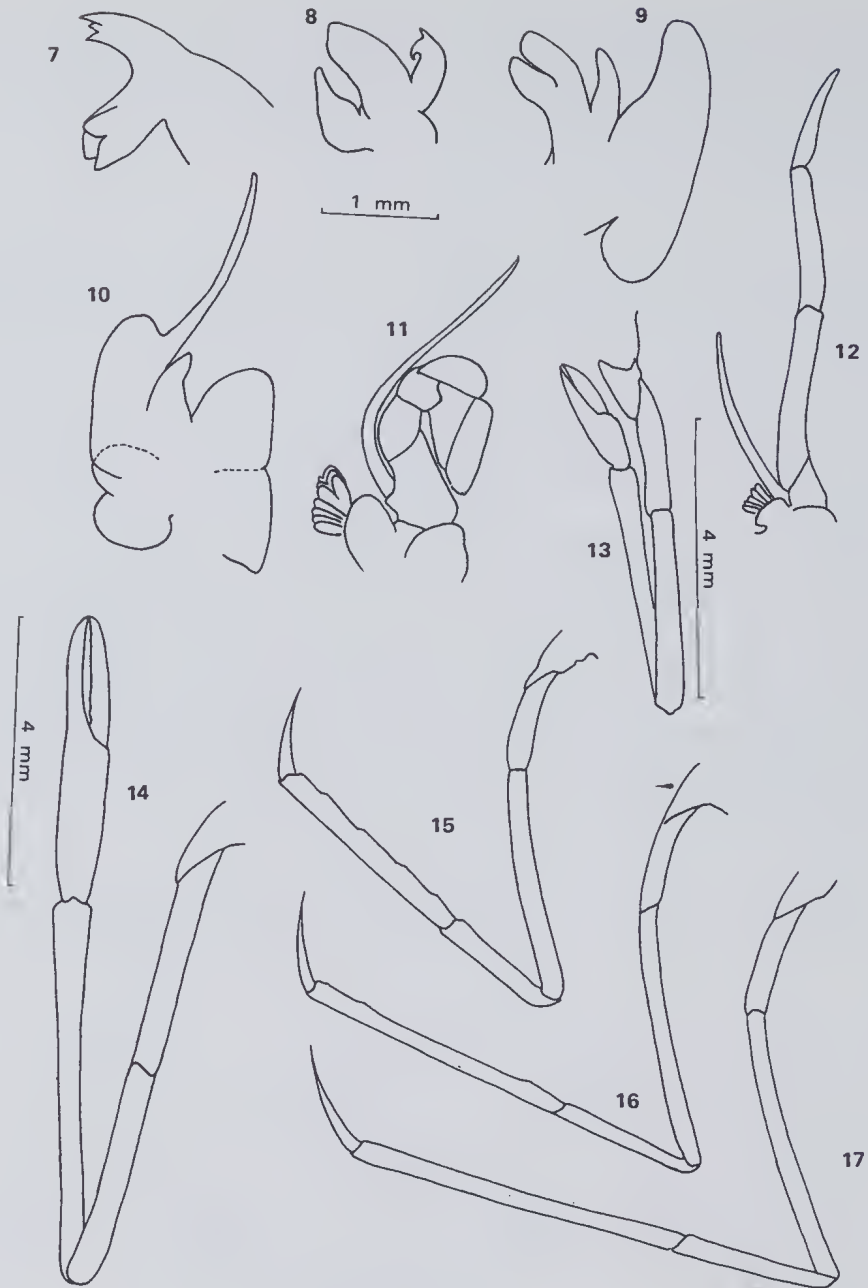
Telson (Fig. 4) with two pairs of dorsal spines arranged in a rectangle in posterior half. Posterior margin of telson pointed, with a pair of plumose setae and two pairs of stout spines, outer pair about one third length of inner pair.

Eyes stout, cornea pigmented, broader and shorter than stalk.

Antennular peduncle (Fig. 5) with stylocerite reaching midlength of basal segment; lateral margin of basal segment straight, with anterolateral spine not projecting beyond convex anterior margin; second segment about as long as distal segment, combined lengths of second and distal segments three quarters length of basal segment. External antennular flagellum bifurcate; fused portion of 10 segments, three fifths length of free portion of thickened ramus of three segments.



Figs 3-6, *Palaemonetes australis*: 3, anterior margin of carapace with antennal, branchiostegal spines and branchiostegal groove (x11); 4, telson and right uropod (x7); 5, left antennular peduncle (x7); 6, right scaphocerite (x7).



Figs 7-17, *P. australis*: 7, right mandible; 8, left first maxilla; 9, left second maxilla; 10, right first maxilliped; 11, right second maxilliped; 12, right third maxilliped; 13, left first pereopod; 14, left second pereopod; 15, left third pereopod; 16, left fourth pereopod; 17, left fifth pereopod; Magnifications: 7-12 (x15), 13-17 (x9). Figs 7-12: based on female paratype W.A.M. 93-75.

Scaphocerite (Fig. 6) four times as long as wide; lateral margin straight with distal tooth prominent but not reaching tip of scaphocerite.

Mandible (Fig. 7 figured female WAM 93-75) with incisor process toothed and molar section rectangular; mandibular palp absent. First maxilla (Fig. 8) with three stout lobes, endopodite with bifid tip. Second maxilla (Fig. 9) with three lobes, inner lobe bifid, endopodite tapers to a point, scaphognathite three times as long as wide. First maxilliped (Fig. 10) with five lobes, inner lobes broad with straight inner margins, endopodite tapered, exopodite long tapered extension of lateral lobe, epipodite bilobed with rounded margins. Second maxilliped (Fig. 11) hook shaped with long tapered exopodite and rounded epipodite bearing a bilobed podobranch. Third maxilliped (Fig. 12) reaching tip of antennal peduncle; exopod as long as ischiomerus; distal segment three quarters length of carpus; carpus four fifths length of ischiomerus.

First pereopod (Fig. 13) reaching anterolateral spine of scaphocerite; fingers as long as palm; chela half length of carpus; merus three quarters length of carpus.

Second pereopod (Fig. 14) reaching beyond scaphocerite by half of chela; fingers three quarters length of palm; chela four fifths length of carpus; merus three quarters length of carpus.

Third pereopod (Fig. 15) reaching short of tip of scaphocerite; dactylus two fifths length of propodus; carpus three fifths length of propodus and half length of merus.

Fourth pereopod (Fig. 16) reaching short of tip of scaphocerite; dactylus one third length of propodus; carpus half length of propodus and half length of merus.

Fifth pereopod (Fig. 17) reaching short of tip of scaphocerite; dactylus one third length of propodus; carpus four ninths length of propodus and half length of merus; propodus with five transverse rows of setae in posterodistal region.

First pleopod (Fig. 18) with endopod less than one third length of exopod.

Eggs in late stage of development attached to pleopods, measuring 1.6 x 1.1 mm.

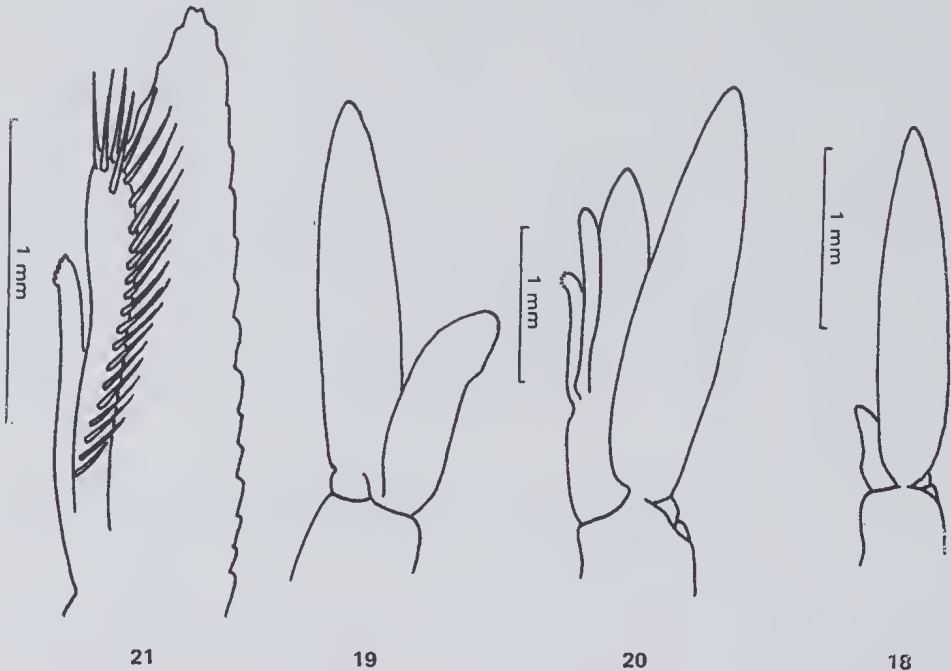
Figured male (WAM 92-75).

Endopod of first pleopod (Fig. 19) without appendix and reaching to midlength of exopod. Appendix masculina on endopod of second pleopod (Figs. 20, 21) reaching midway between appendix interna and tip of endopod; armed with outer apical row of three spines and inner row of 18 spines.

Variation in paratypical series

In the series of 290 specimens examined, variation was found in the rostrum, external antennular flagellum, first and second pereopods, appendix

masculina and mandible. In each character some of the variation was associated with growth.



Figs 18-21, *Palaemonetes australis*; 18, right first pleopod, female, W.A.M. 93-75 (x23); 19, right first pleopod, male (x20); 20, right second pleopod, male; 21, right appendix masculina (x40). Figs 19-21: mala paratype W.A.M. 92-75.

Rostrum — Dorsal margin armed with five to seven (occasionally four, rarely eight) teeth, one to two teeth posterior to orbit. Tip of rostrum usually bifid but may be trifid or single pointed (commonly single pointed for about three of the initial post-larval stages). Ventral margin with two to four teeth.

External antennular flagellum — Bifurcate, fused basal portion of five to ten segments, free portion of thickened ramus with one or more segments in juveniles and up to 15 segments in adults when it may be twice length of fused portion.

First pereiopod — Chela about nine tenths length of carpus in small juveniles and half length of carpus in adults.

Second pereiopod — Fingers as long as palm in juveniles but three quarters length of palm in adults. Chela as long as carpus in juveniles but about four fifths length of carpus in adults.

Appendix masculina — Not apparent in specimens less than 12 mm total length. Males between 12-14 mm total length bear a short appendix without spines. In mature males (greater than 24 mm total length) the appendix is

armed with an outer apical row of three to five spines and an inner row of 5-22 spines.

Mandible — Mandibular palps are present in some specimens from all samples studied. The structure of the mandibular palp is variable and palps were classified into four types: palp absent (A), small lump without setae (B), palp with single segment and with setae (C), and palp with two segments and with setae (D) (Fig. 22).

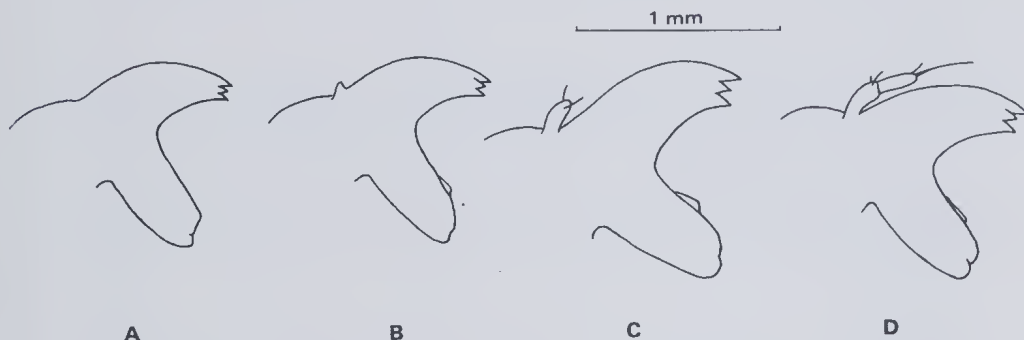


Fig. 22: Mandibles in *Palaemonetes australis*; A, without palp, B, with palp as small lump; C, palp with one segment and setae; D, palp with two segments and setae.

Table 1 gives the frequency of each variant in samples from south west locations. Although the frequencies at four locations within the Swan River were homogeneous ($X^2_{(3)} = 1.67, 0.9 > P > 0.5$) the frequencies varied between populations from different river systems ($X^2_{(3)} = 17.9, P < 0.001$). However, a pattern of variation indicating a latitudinal cline in frequency was not apparent.

Left and right mandibles sometimes differed in the structure of the mandibular palp (Table 2). The variation appeared to be random although Swan River specimens were more variable than those from other river systems. The presence of the palp was not related to sex and animals with and without palps were collected together at all locations. Mandibular palps were not present in shrimp less than 12 mm total length.

Observations were carried out in the laboratory to assess the natural variance in the form of the mandibular palp in controlled broods from single females of known mandibular palp type. The offspring from eight egg-bearing females without mandibular palps (type A) were reared to total lengths of 15-17 mm and their mandibles examined. Of the 21 surviving offspring, 9 possessed mandibular palps and 12 had no palp. A single female with mandibular palps (type C) gave rise to 3 offspring, 1 with palp and 2 without palps.

Table 1: Mandibular palps in *P. australis* from four south west Australian river systems. Palps were classed as: A without palp, B small lump without setae, C palp with one segment and setae, and D palp with two segments and setae, as shown in Fig. 22. The number of mandibles examined, 'n', is also listed.

CLASS OF PALP

LOCATION	A	B	C	D	n
Moore River	104	10	5	1	120
Lower Swan River	35	16	0	9	60
Middle Swan River	85	13	4	19	120
Upper Swan River	39	9	3	9	60
Avon (Swan) River, York	38	7	13	2	60
Combined Swan River	196	45	20	39	300
Murray River	44	7	1	8	60
Hardy Inlet	51	4	2	3	60
Taylor Inlet	5	0	0	1	6
Esperance	9	0	0	1	10

Table 2: Frequencies for the presence of similar palps, and combinations of different palps, on left and right mandibles. Palp classification as for text in Table 1.

LOCATION	FREQUENCIES OF PALP TYPES			
	AA or BB or CC or DD	AB or BC or CD	AC or BD	AD
Moore River	55	4	1	0
Lower Swan River	21	6	2	1
Middle Swan River	46	7	2	5
Upper Swan River	20	5	3	2
Avon (Swan) River, York	20	5	3	2
Combined Swan River	107	23	10	10
Murray River	22	5	1	2
Hardy Inlet	28	1	1	0

Colour pattern

Live specimens translucent. The overall colour is typically olive-green or brown and is produced by combinations of chromatophores with red, white,

yellow and blue pigments. The intensity of colour varies with the habitat and animals on pale substrates are almost transparent.

Carapace (Fig. 2) with diffuse dorsal and anterior bands of chromatophores and indistinct mottled pattern posteriorly. Thickened ramus of bifid antennular flagellum light red.

Mature ovaries green or brown in live specimens and usually orange when preserved. Live eggs green or brown in early stages of development and transparent with black eyes when mature. Preserved eggs usually orange.

Size

First stage juveniles 5-6 mm total length. Males mature at about 22 mm length and reach maximum lengths of about 30 mm; Females mature at about 24 mm and reach maximum lengths of about 34 mm.

Eggs large, measuring about 1.0 x 1.4 mm in early stages of development and about 1.4 x 1.9 mm when mature. Number of eggs rarely exceeding 70 per brood.

Reproduction

Females bearing eggs were collected between September and April and the peak of breeding is in November. Incubation period is about one month and an individual female appears to lay about 3-4 batches of eggs throughout the season.

Distribution

Rivers, lakes and estuaries of south west Australia from Esperance to Hill River. In regard to salinity tolerance, adult specimens were collected in Canning River (less than 1^o/oo) and in Leschenault Inlet (15-44^o/oo; no specimens have been found in habitats where the salinity is permanently higher than 25^o/oo).

Feeding and Habitat

The gut usually contains a brown gelatinous bolus which when teased apart is shown to contain sand grains and small pieces of shell; in addition complete or damaged copepods, amphipods, chironomid larvae, diatoms or foraminifera may occur.

In aquaria the activity pattern varies with time of day. Most shrimp remain inactive in shaded positions by day and become active at night, occasionally swimming clear of the substrate. In the field *P. australis* usually inhabits shallow water areas, shaded by reeds and other vegetation. Shrimp are rarely taken in areas of strong current flow or in still water which may become deoxygenated.

*PALAEMONETES ATRINUBES** sp. nov.

Remarks

*This name refers to the internal black spot visible at the posterior end of the sixth abdominal segment in live specimens.

Diagnosis

A species of *Palaemonetes* with rostral formula 4-7/2-4, bifid tip and dorsal margin without teeth for about one third of its length in distal region; branchiostegal spine located on anterior margin of carapace; fused basal portion of bifid antennular flagellum about twice as long as free portion of thickened ramus; first pereopod reaching short of tip of scaphocerite; chela of first pereopod about half length of carpus; second pereopod reaching by half of chela beyond tip of scaphocerite; second chela about three quarters length of carpus, and eggs measuring 0.5 x 0.9 mm.

Material examined

Holotype — Adult female, 34 mm total length, Canning Bridge, lower Swan River, 23.11.73, WAM 106-75.

Paratypes — 57 males (12-35 mm total length), 60 females (12-40 mm total length), 6 juveniles (8-11 mm total length) from Swan River estuary, Bay of Rest, Exmouth Gulf; Wapet Creek, Exmouth Gulf; Gladstone, Shark Bay, and Cockatoo Island, WAM 94-75, 95-75, 105-75, 104-75, 98-75, 515-73, 456-73, 519-73.

Drawings are based on the holotype except for drawings of mouthparts and pleopods which were based on material dissected from paratypes as indicated in the descriptions.

Description of holotype

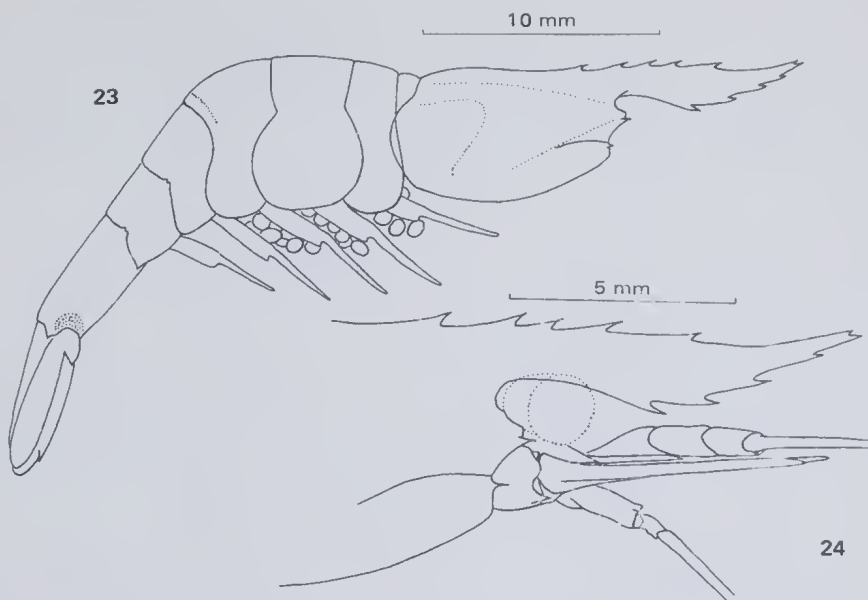
Rostrum (Figs. 23, 24) curving upward at tip, reaching slightly beyond scaphocerite; dorsal margin with five teeth, first tooth distant from bifid tip by about one third of rostral length, fifth tooth behind orbit and slightly distant from anterior teeth; ventral margin with four teeth.

Carapace smooth; branchiostegal spine (Fig. 24) located on anterior margin of carapace; branchiostegal groove commencing at anterior margin of carapace slightly above branchiostegal spine, curving ventrally beyond that spine.

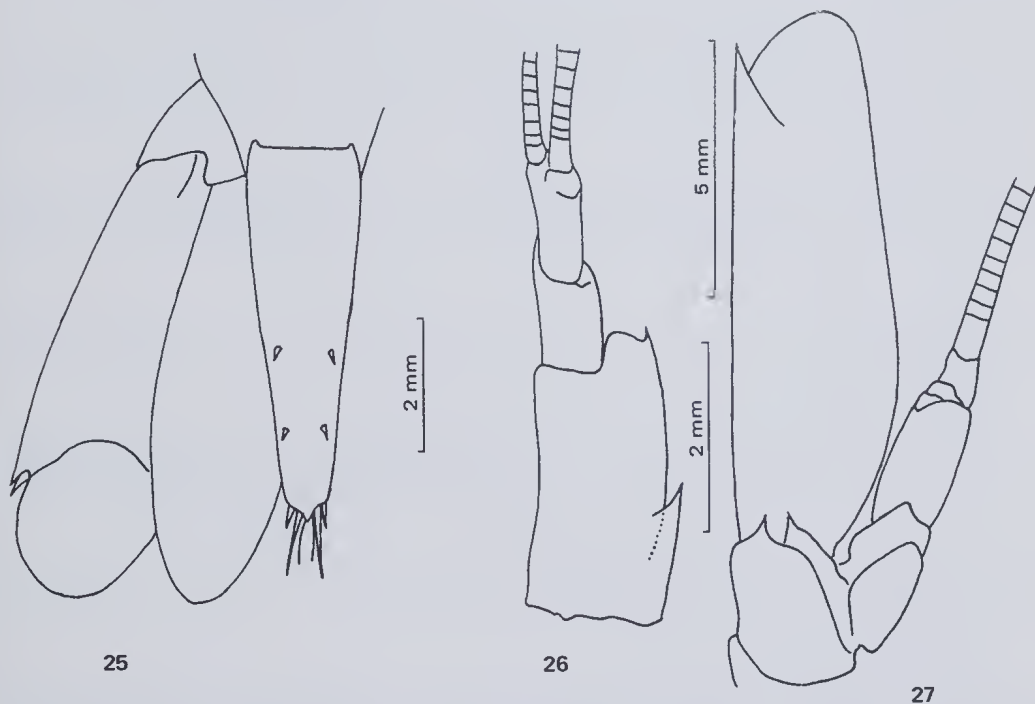
Pleura of three anterior abdominal segments rounded (Fig. 23), fourth pleura bluntly acute, fifth pointed and slightly acute. Sixth segment twice length of fifth and equal to telson. Third abdominal segment slightly recurved posteriorly if viewed laterally (Fig. 23).

Telson (Fig. 25) with two pairs of dorsal spines arranged in a rectangle, all in posterior half. Posterior margin of telson pointed, with a pair of plumose setae and two pairs of stout spines, outer pair about half length of inner pair.

Eyes stout; cornea pigmented, broader and shorter than stalk.



Figs 23, 24, *Palaemonetes atrinubes*: 23, overall body shape, colour pattern shown stippled (x3); 24, anterior region (x6).



Figs 25-27, *Palaemonetes atrinubes*: 25, telson (x8); 26, right antennular peduncle (x12); 27, right scaphocerite (x6).

Antennular peduncle (Fig. 26) with stylocerite reaching short of mid-length of basal segment; lateral margin of basal segment straight with antero-lateral spine projecting slightly beyond convex anterior margin; combined length of second and distal segments two thirds length of basal segment. External antennular flagellum bifurcate, fused basal portion of 16 segments twice length of free portion of thickened ramus of 6 segments.

Scaphocerite length about four times width (Fig. 27); lateral margin straight with distal tooth prominent, reaching short of distal margin of blade.

Mandible (Fig. 28, female figured WAM 95-75) with incisor process toothed and molar process rectangular in section, mandibular palp absent. First maxilla (Fig. 29) with three lobes, endopodite with bifid tip. Second maxilla (Fig. 30) with three lobes, inner lobe bifid, endopodite tapers to a point, scaphognathite length three times width. First maxilliped (Fig. 31) with five lobes, inner lobes broad, endopodite tapered, exopodite long tapered extension of lateral lobe, epipodite bilobed with rounded margins. Second maxilliped (Fig. 32) hook-shaped with long tapered exopodite and rounded epipodite bearing a bilobed podobranch. Third maxilliped (Fig. 33) reaching tip of antennal peduncle; exopod equal to ischiomerus; distal segment three quarters length of carpus; carpus slightly shorter than ischiomerus.

First pereopod (Fig. 34) reaching tip of scaphocerite; fingers equal to palm; chela half length of carpus and three fifths length of merus.

Second pereopod (Fig. 35) with half of palm reaching beyond scaphocerite; fingers three fifths length of palm; chela four fifths length of carpus and equal to merus.

Third pereopod (Fig. 36) reaching short of scaphocerite tip; dactylus one third length of propodus; carpus half length of propodus and two fifths length of merus.

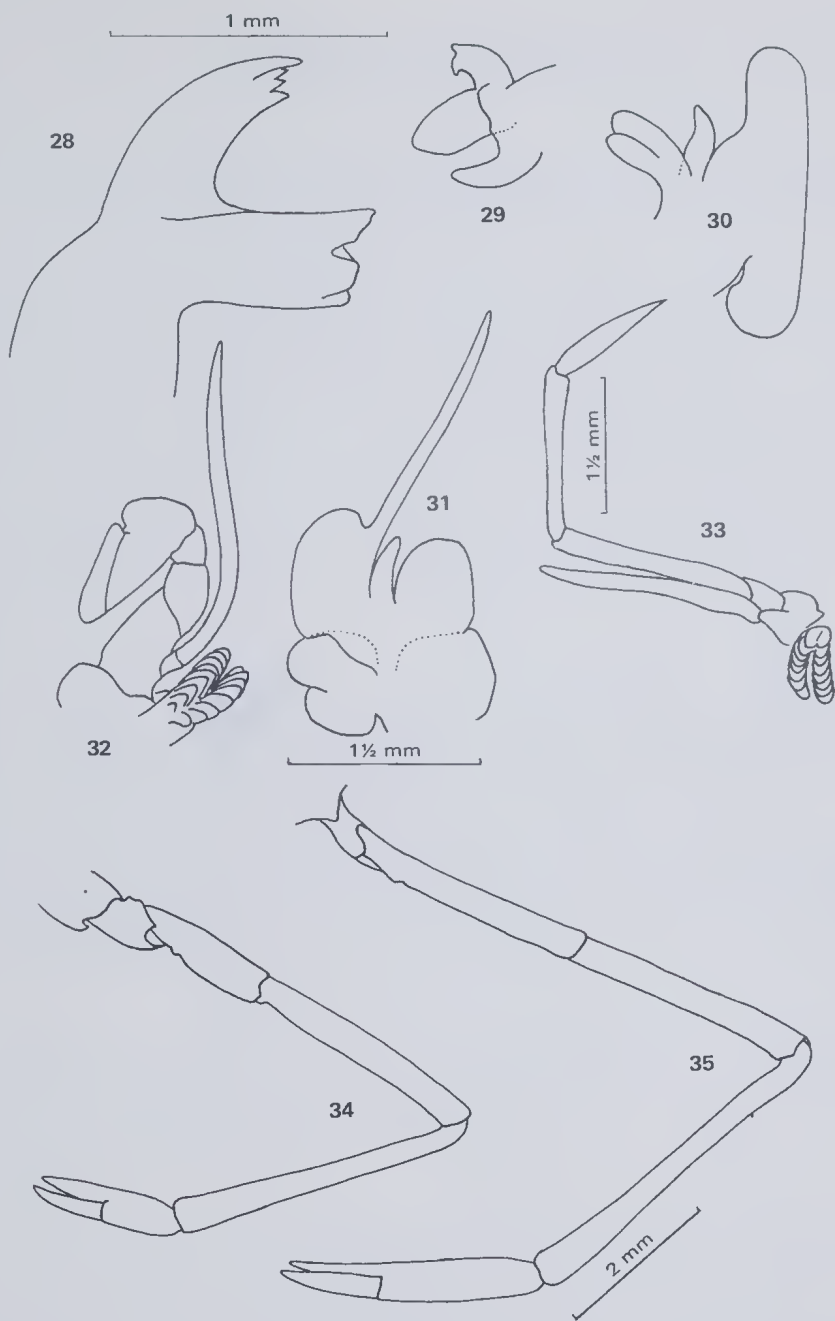
Fourth pereopod (Fig. 37) reaching almost to tip of scaphocerite; dactylus one quarter length of propodus; propodus twice length of carpus and equal to merus.

Fifth pereopod (Fig. 38) reaching tip of scaphocerite; dactylus one quarter length of propodus; propodus twice length of carpus and slightly longer than merus; postero-distal region of propodus with seven transverse rows of setae on left leg and five rows on right leg.

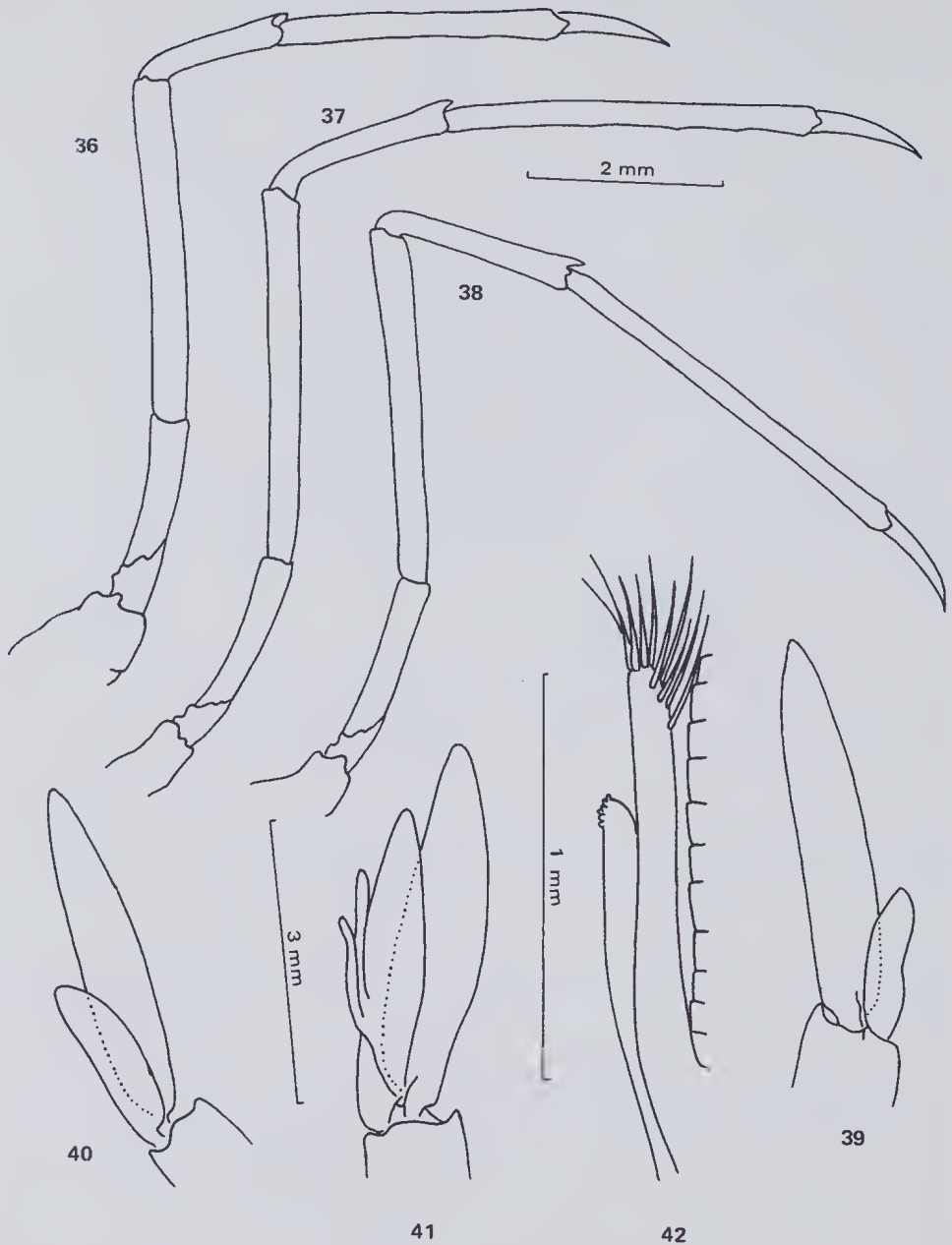
First pleopod (Fig. 39) with endopod about one third length of exopod; endopod with concave inner margin.

Figured Male (WAM 94-75).

Endopod of first pleopod (Fig. 40) without appendix and reaching mid-length of exopod. Appendix masculina on endopod of second pleopod (Fig. 41, 42) reaching midway between appendix interna and tip of endopod; armed with outer apical row of five spines and inner row of five spines.



Figs 28-35, *Palaemonetes atrinubes*: 28, left mandible; 29, right first maxilla; 30, left second maxilla; 31, right first maxilliped; 32, right second maxilliped; 33, left third maxilliped; 34, right first pereiopod; 35, right second pereiopod. Magnifications: 28, x35; 29-32, x16; 33-35, x10. Figs 28-33: female paratype WAM 95-75.



Figs 36-42, *Palaemonetes atrinubes*: 36, right third pereopod; 37, right fourth pereopod; 38, right fifth pereopod; 39, right first pleopod, female, W.A.M. 95-75; 40, left first pleopod, male; 41, left second pleopod, male; 42, right appendix masculina. Magnifications: 36-38 x12, 39-41 x12, 42 x52. Figures 40-42: male paratype W.A.M. 94-75.

Variation in paratypical series

In the series of 110 specimens examined, variation was found in the rostrum, external antennular flagellum, second pereopod and appendix masculina.

Rostrum — tip of rostrum usually bifid and rarely trifid. Dorsal margin armed with 4-7 teeth, usually 4-6 in juveniles and 5-6 in adults. Ventral margin usually with 3-4 teeth and occasionally 2 teeth. The location of teeth was constant and as described in the holotype.

External antennular flagellum — bifurcate, fused basal portion of 8-20 joints, free portion of thickened ramus with 1-3 joints in juveniles and up to 10 joints in adults when it is about half length of fused portion.

Second pereopod — reaching to tip of scaphocerite in juveniles and with most of chela beyond scaphocerite in adults. Fingers three fifths to four fifths length of palm. Chela two thirds to four fifths length of carpus.

Appendix masculina — appendix masculina in mature males overreaching appendix interna, armed with outer apical row of 3-5 spines and inner row of 4-16 spines.

Colour pattern

Live specimens transparent with distinct lines of red-blue chromatophores on the carapace (Fig. 23) and a single line on the posterior margin of the third abdominal segment; a black spot is clearly visible in the tissue at the posterior end of the sixth abdominal segment.

Mature ovaries green or brown in live specimens and often orange when preserved. Live eggs on abdomen green or brown in early stages of development; transparent with blue chromatophores and black eyes when mature. Preserved eggs usually orange.

Size

In the lower Swan River average total length was 31 mm for adult males and 36 mm for adult females. Eggs measured 0.5 by 0.9 mm and numbered between 90 and 200 per female.

Reproduction

In the lower Swan River females larger than 32 mm total length were found to bear eggs in summer between November and February. In the sample from Exmouth Gulf (WAM 515-73) females as small as 24 mm total length carried eggs. In the laboratory, groups of 6-10 females held at salinities of 15^o/oo, 25^o/oo, and 35^o/oo bred only at the higher salinities.

Distribution

Estuarine and marine habitats from Leschenault Inlet to Cockatoo Island.

Feeding and habitat

Gut contents consist largely of detritus and small crustaceans such as amphipods and ostracods.

Usually inhabits shallow water close to the shore over a substrate of mud or detritus. Unlike *P. australis*, which seeks shelter by day, *P. atrinubes* was often found swimming above the substrate during the day.

Discussion

Because variation in the morphology of the mandibular palp has been recorded for *Palaemon debilis* (Chace, 1972), for 4 other species of *Palaemon* (Fujino and Miyake, 1968) and for *Palaemonetes australis* (this work), the key proposed by Holthuis (1955) to separate the genera of Palaemoninae and the subgenera of *Palaemon* is not wholly satisfactory. For instance, those individuals of *P. australis* lacking a mandibular palp would be placed in the genus *Palaemonetes*, those with a palp of 2 segments would be placed in the genus *Palaemon* subgenus *Palaemon* and no classification exists for those specimens of *P. australis* with a palp of only 1 segment. Nevertheless, the key appears to be satisfactory for the majority of Palaemoninae, especially those in America and Europe, and both Chace (1972) and Holthuis (pers. comm. 1973) have suggested that it be retained pending a comprehensive review.

A satisfactory key for the Palaemoninae of a region can be constructed and the following key sets out the main characteristics distinguishing adults of those species in Australia: *Palaemonetes australis*, *Palaemonetes atrinubes*, *Palaemon serenus* and *Palaemon litoreus*. The key also provides distinguishing features for the genus *Macrobrachium**.

1. Branchiostegal spine present 2
Branchiostegal spine absent, hepatic spine present . . . genus *Macrobrachium* (freshwater and estuarine habitats in north and central Australia, except *M. intermedium* which occupies marine and estuarine habitats of southern half Australia).
2. Mandible with palp of three joints *Palaemon* 3
Mandible without palp or with palp of less than three joints . . . *Palaemonetes* 4
3. Second pereopod with carpus longer than palm of chela, fused basal portion of bifid antennular flagellum about half length of free part of thickened ramus . . . *Palaemon serenus* (marine)

*Riek (1951) has presented a key for the Australian freshwater species of *Macrobrachium* and Mr T. M. Walker (University of Tasmania) is currently revising this group.

and estuarine habitats of southern half of Australia).

Second pereopod with carpus shorter than palm of chela, fused basal portion of bifid antennular flagellum about one third length of free portion of thickened ramus . . . *Palaemon litoreus* (marine habitats of southern half of Australia)

4. Rostrum with dorsal margin unarmed for about one third its length in distal region, branchiostegal spine located on anterior margin of carapace . . . *Palaemonetes atrinubes* (marine and estuarine habitats of north-west Australia).

Rostrum with dorsal margin armed with regularly spaced teeth along its length, branchiostegal spine distant by about its own length from anterior margin of carapace . . . *Palaemonetes australis* (freshwater and estuarine habitats of south-west Australia).

The affinities of *Palaemonetes australis* with *Palaemonetes atrinubes* and with other Australian Palaemoninae are not clear. Groupings of these species based on characters such as general body shape, rostrum, carapace spines, external antennular flagellum, relative lengths of leg segments and egg size would link *Palaemon serenus* and *Palaemon litoreus* together, *Palaemonetes australis* and *Macrobrachium intermedium* form a second group while *Palaemonetes atrinubes* remains without close affinities to any other Australian species.

There is, however, a character that links *P. atrinubes* with *P. australis* and clearly distinguishes them from the other Australian species; this character is the absence of a transverse row of small setae on the anterior midline of the telson. The setae are small and not obvious unless closely examined. They were not mentioned by Yaldwyn (1954) in his description of *Palaemon affinis* but are shown in his drawing of the telson and they do occur in the specimens examined of *P. serenus* and *M. intermedium*.

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